

Detection of Coronary Artery Disease in Patients with a Permanent Pacemaker

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Cardiac pacing has been used in the treatment of bradyarrhythmia for more than 50 years, and throughout that time period both clinical practice and an impressive amount of research have objectively proven its effectiveness. Especially in the last decade the number of patients treated with a permanent pacemaker implantation has increased, and due to the aging of the population this number continues to grow [1]. Importantly, the prevalence of coronary artery disease (CAD) in these patients is high and most patients will develop symptoms suggestive of angina pectoris. As a consequence, the use of noninvasive testing has increased in these vulnerable subjects to prevent additional invasive assessment or intervention. Noninvasive methods for the detection and diagnosis of CAD in patients with a permanent pacemaker, recommended by the American College of Cardiology/American Heart Association (ACC/AHA) guidelines, include adenosine or dipyridamole perfusion imaging and dobutamine stress echocardiography [2]. However, in the last decade studies have demonstrated pitfalls and weaknesses of these imaging modalities in patients with a permanent pacemaker [3–6]. Single-photon emission computed tomography (SPECT) with either thallium or technetium is routinely used for ischemia detection, but in patients with a pacemaker perfusion defects that were not related to obstructive CAD have been demonstrated [3, 6]. False-

positive defects are mainly observed in the inferoposterior, inferior, and apical myocardium, which could be explained by differences in regional blood flow during ventricular pacing [4]. Importantly, these perfusion abnormalities are more prominent during physical exercise compared with pharmacological stress using dipyridamole or adenosine [5].

Stress echocardiography is usually performed using pharmacological stressors such as dobutamine or dipyridamol. Dobutamine stress echocardiography has been extensively studied in patients undergoing noncardiac surgery [7]. Through the infusion of dobutamine, positive chronotropic and inotropic effects increase myocardial oxygen consumption. In pacemaker-dependent patients, wall motion abnormalities are present because of an altered ventricular activation; consequently, the interpretation of dobutamine stress echocardiography can be misleading. Furthermore, Ciaroni et al. [8] suggested that the presence of chronotropic incompetence may reduce the accuracy of dobutamine stress echocardiography.

Pacing stress echocardiography (PASE) using atrial pacing through the esophagus has been successfully used since the 1980s for the detection and risk stratification of CAD [9]. Importantly, in contrast to dobutamine stress echocardiography, PASE only has positive chronotropic effects and no inotropic effects. Modi et al. [10] summa-

rized studies on PASE and reported a sensitivity between 79 and 95% and a specificity between 71 and 100%. In addition, they observed an accuracy of 90% for PASE in the detection of CAD compared with standard coronary angiography. Recently, a novel method for cardiac pacing was introduced which uses PASE with a permanent pacemaker.

In this issue of *Cardiology*, Shimoni et al. [11] describe the results of their study in which an evaluation was made between the diagnostic accuracy of PASE compared with dipyridamol thallium-201 SPECT. A group of 58 patients with a permanent pacemaker and known or suspected CAD was studied. Both PASE and SPECT were performed in 53 (91%) patients, and the concordance in terms of a positive test result was 75%, with a κ value of 0.64. The sensitivity and specificity of PASE were 87 and 78% compared with 96 and 57% for SPECT. Before the present study, several small single-center studies tested the ability of PASE for the detection of CAD [12–14]. A comparison between these studies has limitations, as none of them used the same stress and pacing protocols. Overall, the sensitivity and specificity of PASE ranged from 77 to 96 and from 68 to 88%, respectively, depending on gender and age [14]. The authors observed a concordance of 75% ($\kappa = 0.64$) between PASE and SPECT in detecting CAD. A κ value between 0.61 and 0.80 means that there is substantial concordance between the 2 tests.

In addition to the testing results, Shimoni et al. [11] described the prognostic value of PASE in patients with a

permanent pacemaker. During a widely distributed follow-up period of 51 months (range 3–68 months), 8 cardiac deaths occurred and 24 cardiac events were observed. Multivariate regression analyses showed that only positive PASE was associated with the occurrence of cardiac events. Although these results seem to be in line with previous results of larger studies [14, 15], they need to be interpreted with caution due to the limited number of patients and cardiac events in the present study.

In summary, Shimoni et al. [11] describe the value of a novel noninvasive technique in the cardiac evaluation of elderly patients with a permanent pacemaker. Compared with SPECT, the use of PASE has acceptable sensitivity and specificity for the detection of CAD in these patients. Although the concordance between PASE and SPECT regarding a positive test result is substantial, it is important to acknowledge the fact that PASE and SPECT are intrinsically different techniques. Whereas in SPECT myocardial perfusion is studied, PASE is directed at wall motion abnormalities. Expected advantages of PASE are that it is cost-effective, radiation-free, and less time-consuming than SPECT. Major limitations of the present study include: (1) a nonrandomized design, (2) PASE and SPECT were not both performed in all patients, and (3) coronary angiography was not routinely performed. In conclusion, this study demonstrated that PASE is a promising novelty for detecting ischemia in pacemaker-dependent patients, but further evaluation is required in prospective, randomized, comparative studies.

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